

**CLAIMS:**

1. A method for transmitting simultaneously over a telephone subscriber wire pair by means of a system which includes a discrete multi-tone (DMT) line signal unit producing a plurality of carriers of different frequency in which each carrier is modulated by a stream of QAM symbols and transmits a number of bits of information for QAM symbol correlated with the signal-to-noise ratio measured by each carrier during an initialization process, which method comprises the steps of:
  - 10 A. converting at least one voice signal into a corresponding sequence of n-bit digital words in synchronization with said frames of said DMT line signal,
  - B. assigning for voice transmission a portion of said plurality of carriers, said portion containing carriers each characterized by the ability to transmit a number of bits equal or larger than n per QAM symbol,
  - C. assigning other carriers of the DMT line signal for data transmission,
  - 15 D. converting said sequence corresponding to said voice signal of n-bit digital words into at least one respective sequence of n-bit QAM symbols in such a way as to minimize the probability of error for more significant bits of said digital word; and
  - E. sending said at least one sequence of QAM symbols in synchronization with said sequence of n-bit digital words on respective carriers assigned for voice transmission.
2. A method according to Claim 1 wherein several carriers of said assigned portion of carriers may be reassigned for data carrying when upon analysis the respective voice channels are identified as silent.
- 25 3. A method according to Claim 1 and wherein said n-bit digital words and said n-bit QAM symbols are 8-bit integers respectively.
4. A method according to Claim 1 and wherein said at least one voice signal is converted to a respective sequence of n-bit digital words by PCM encoding.

5. A method according to Claim 1 and wherein said at least one voice signal is associated with at least one respective telephone channel in analog or in digital form.

6. A method according to Claim 1 and wherein several carriers of said assigned portion of carriers may be reassigned for data carrying when upon analysis of a telephone signaling the respective telephone channels are identified as silent.

7. A transmitter included in a system for transmitting a voice signal and digital data over a telephone subscriber wire pair linked to a digital data source through a digital interface port, the system being provided with a discrete multi-tone line signal unit (DMT) producing a plurality of carriers having different frequencies and employing tone-ordering means for assigning said data to carriers of the DMT signal, and employing a first constellation encoder connected to an (IDFT) Inverse Discrete Fourier Transformation processor to modulate the carriers of said DMT signal assigned to data transmission, said transmitter comprising:

- 15 A. at least one voice interface port connected to a corresponding at least one external voice signal source,
- B. at least one converter circuit connected to said corresponding at least one voice interface port for converting said voice signal into at least one sequence of n-bit digital words,
- 20 C. a second tone-ordering means connected to said at least one converter circuit to assign a portion of said carriers of said DMT signal to voice transmission,
- D. a second constellation encoder receiving said at least one sequence of n-bit digital words, connected to said IDFT processor to modulate said portion of said carriers assigned to voice transmission by at least one sequence of n-bit QAM symbols, wherein said at least one sequence of n-bit QAM symbols corresponds to said at least one sequence of n-bit digital words,

5        E. a synchronization circuit connected to said at least one converter circuit and to said IDFT processor to provide synchronization between frames of said DMT signal and said sequence of said n-bit digital words, and

      F. a digital to analog converter connected to said IDFT processor for sending DMT signal over said twisted wire pair.

10      8. A transmitter according to Claim 7 wherein said at least one external voice source is at least one analog telephone channel and said least one converter circuit is at least one (PCM) pulse code modulation encoder, and wherein at least one voice interface port is connected to said at least one PCM encoder respectively to transform said at least one voice signal of said at least one telephone channel into at least one corresponding sequence of n-bit PCM words, and wherein said at least one PCM encoder is connected to said second tone ordering means, and wherein said at least one PCM encoder and said IDFT processor are connected to a synchronizer for synchronizing said DMT frames with said at least one sequence of n-bit digital words of said PCM encoder.

15      9. A transmitter according to Claim 7 and wherein said at least one voice signal arrives through at least one external telephone channel connected to said at least one voice interface port.

20      10. A transmitter according to Claim 7 and wherein a processor for analyzing voice at said at least one voice interface port, is connected to a carrier allocator, sending it instructions to reassign carriers formerly assigned to voice transmission, to data transmission upon the identification of corresponding voice channel as being silent.

25      11. A transmitter according to Claim 7 and wherein said subscriber wire pair is a twisted wire pair.

30      12. A transmitter according to Claim 8 and wherein a plurality of voice interface ports are connected to a corresponding number of PCM encoders, and wherein a PCM concentrator is connected to said PCM encoders and to said second tone ordering means.

13. A transmitter according to Claim 9 and wherein a processor for analyzing telephone control signals at said telephone channel, is connected to a carrier allocator, sending instructions to reassign carriers formerly assigned to voice transmission to data transmission upon the identification of corresponding 5 telephone channel as being silent.

14. A transmitter according to Claim 9 and wherein said at least one voice interface port is a PCM voice interface port connected to an external PCM telephone channel equipment of a telephone station, to said second tone ordering means and to a synchronizer connected to said IDFT processor for synchronizing 10 said DMT frames with said at least one sequence of n-bit digital words of said external PCM telephone channel equipment.

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